

Using Co-Designing as a Method to Develop COVID-19 Vaccination
Information for Low-Literacy Hispanic Individuals

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Abstract

This study aims to co-design health educational material that could aid in the understanding of COVID-19 vaccination rates among the Spanish-speaking population, by focusing on improving the engagement of low-literacy individuals. This study explored 3 different formats of engaging with low-literacy individuals about COVID-19 vaccine information: through an SMS bi-directional conversation chat bot system, through infographics, and through a series of short videos. The study was designed with 2 stages and 2 separate sets of participants. The first stage involved a focus group with bilingual Spanish-speaking co-creator participants that helped design and develop the educational material later used in the study. The second stage involved individual interview sessions with native Spanish-speaking test participants that reviewed and assessed the three different formats of the educational material. The study measured test participants pre- and post-session knowledge about the COVID-19 vaccine to determine if the educational material presented had an impact on their answers. Additionally, test participants were asked to rate which format they preferred most and least, and to describe why. The goal of this study is to investigate a collective approach to developing health educational material for Spanish-speaking individuals and to examine 3 non-traditional formats of displaying health information.

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Chapter 1: Introduction

There is a direct relationship between low health literacy and low vaccination rates, and low health literacy correlates strongly with low literacy in general (El-Sherif, 2019; Obi-Jeff et al., 2021). The Program for the International Assessment of Adult Competencies (PIAAC) found that 34% of U.S. adults with low literacy skills are of Hispanic ethnicity (National Center for Education Statistics, 2019). These correlations place the Hispanic community in the U.S. at an increased risk of not receiving the COVID-19 vaccine, which is one of the best ways to prevent severe illness during the current pandemic. This study aimed to co-design health educational material that could aid in the uptake of COVID-19 vaccination rates among the Spanish-speaking population, by focusing on improving the engagement of low-literacy individuals. This study explored three different formats of engaging with low-literacy individuals: through an SMS bi-directional conversation chat bot system, through infographics, and through a series of short videos.

The study was designed with two stages and two separate sets of participants. The first stage involved a focus group with bilingual Spanish-speaking co-creator participants that helped design and develop the educational material later used in the study. The second stage involved individual interview sessions with test participants that reviewed and assessed the three different formats of the educational material. The study measured test participants' pre- and post-session knowledge about the COVID-19 vaccine to determine if the educational material presented had an impact on their answers. Additionally, test participants were asked to rate which format they preferred most and least, and to describe why. The goal of this study is to investigate a collective approach to developing educational material for Spanish-speaking individuals and to examine three less-traditional formats of displaying health information.

Chapter 2: Literature Review

Low Health Literacy and English Language Learners

Health literacy is defined as the ability to access, understand, and use health information to make appropriate health decisions (Institute of Medicine, 2004). There is abundant literature to show that individuals with low health literacy have worse health outcomes because they are less likely to seek health information, have more trouble understanding health information, and are less likely to comply with health guidelines or health care plans (Lopes & McKay, 2020; El-Sherif & Pluye, 2019; Feinberg et al., 2018).

With the availability of the Internet to more and more people, online consumer health information (OCHI) is being used on a regular basis. Factors that can influence the outcomes from OCHI use are education and income. Most of the research in this field shows that individuals with higher income and education are more likely to access OCHI, understand the information, and use it to have better health outcomes. Conversely, individuals with lower education and income are less likely to seek OCHI because they can be discouraged by information they find difficult to understand, thus making it harder to experience positive health outcomes. When people with low literacy levels encounter OCHI websites that offer information accessible to those with low literacy levels, they too report as many benefits as those with higher literacy levels (El-Sherif & Pluye, 2019).

An additional factor in the likelihood to search for health information online is language preference of individuals. In a study by Bjarnadottir et al. (2016), it was found that “age and Spanish as the preferred language were negatively associated with online health information seeking.” Individuals with Spanish as the primary language were significantly less likely to report looking for health information online, compared to those who had English as their primary language. These findings can indicate that acculturation plays a key role in health information seeking. Acculturation is defined as the process of cultural learning where behaviors change through prolonged interactions with a different cultural group. There is a significant difference between the health information seeking

behaviors of first- and second-generation immigrants, with second-generation immigrants being more likely to seek health information online (Bjarnadottir et al., 2016).

Co-Design of Health Educational Information

To make online health information content more engaging for Spanish-speaking individuals, content can be co-designed with the members of that community or equivalent steps should be taken to create culturally appropriate content. Two studies reflect both approaches. First, Ginossar and Nelson (2007) used a collaborative approach to create a health-related website with Hispanic women. The website's content was bilingual, at a low literacy level, and it featured both textual and graphical forms of information. The researchers and stakeholders co-created entertainment-educational material in the form of fotonovelas, or illustrated stories. As part of the research, the stakeholders, called *promotoras*, organized community meetings where they taught community members basic computer skills, how to search for health information online, to reflect on their experiences in the health care system, to learn self-advocacy skills, and to share their knowledge with others in the community. By using this collaborative method in creating and disseminating information, the researchers and *promotoras* were able to successfully reach a usually hard-to-reach, low-income, Hispanic community. Creating health information in this way empowers community members to effect changes in their own communities (Ginossar & Nelson, 2007).

Second, Pagán-Ortiz and Cortés (2021) developed online health educational intervention information for a low literacy level and Spanish-speaking audience. The researchers had an extensive process of preparing the content for the low literacy, Spanish-speaking audience. First, the content was translated from English to Spanish, then vetted by a certified translator and a researcher with expertise in cultural adaptations for Hispanic populations. The content was written using plain, neutral language, the tone was conversational, and it used questions and answers to contextualize the information. Lastly, the content translated from Spanish back to English and vetted again to ensure that it maintained the original meaning. The material they created was successful in

getting the participants to understand the information and make positive changes in their health knowledge and self-efficacy. They evaluated the participants understanding of the material and changes in behavior through a self-report on the usage of the health material. Another important conclusion from the study is that low-income participants use their smartphone to complete online tasks, thus it is critical to ensure that content is not just at a low literacy level but that it is also mobile accessible (Pagán-Ortiz & Cortés, 2021).

Making health content mobile accessible is crucial because according to the study by Bailey et al. (2015), minority adults are increasingly using their mobile phone for Internet access. The study examined the relationship between mobile technology and health literacy, with the goal to use mobile text messaging interventions for health promotion. Their findings show that 90% of individuals with low or marginal literacy report owning a mobile phone and 72% used a text messaging plan' thus utilizing text messaging for health promotion is unlikely to pose a financial burden (Bailey et al., 2015). Additionally, a study by Khoong et al. (2020) assessed how language preferences, smartphone ownership, and clinic type preferences affected technology use for health-related communication. As with previous studies, Khoong, et al., were able to report that individuals who "preferred English or owned a smartphone were more likely to use the Internet for health information." However, even in a diverse population, nearly 4 in 5 individuals own a smartphone, with a large portion using mobile technologies to engage in health care. In addition, their study reported that 35% of participants watched Web-based videos about health, and 30% used email to communicate with clinicians (Khoong et al., 2020).

Different Ways to Present Health Content

The ability for patients to understand the information that their health care provider communicates is directly impacted by their literacy level. Multiple studies show that low-literacy patients have difficulty understanding their health provider's words and can feel uncomfortable and anxious about the interaction. These can inhibit patients with low literacy from effectively engaging in conversations with their health provider and

reduce compliance with care plans. The Feinberg et al. (2018) study shows how patients with low health literacy may need a more interactive form of education to build a partnership with their health provider and co-develop self-care plans. Shifting to a more interactive form of education means that the patient is encouraged to ask more questions, request clarifications, voice concerns, and share in the decision-making process (Feinberg et al., 2018).

Because individuals with low literacy are less likely to benefit from traditional health information, it is especially important to present health information in ways that low-literacy populations can effectively comprehend in order to prompt health behavior changes. Content can be presented in video, graphic, or text format, each with their own advantages. This study used all three formats, and each format will be explored in detail.

First, we will discuss the video content format. In their study, Moran et al. (2016), examined the effectiveness of two formats of entertainment-education videos in producing health knowledge gains in populations with low literacy. The study compared narrative and non-narrative formats for the communication of the health information. Non-narrative health education materials rely on facts, figures, and statistics to communicate the information to the patient; for example, a doctor in a clinic setting explains details about a health topic. Narrative health educational materials embed events and characters into a story which contains implicit or explicit messages about the health topic, for example, a family having a conversation while they are preparing dinner. The study found that a narrative film format is more effective than a non-narrative film format at producing knowledge gains and prompting behavior changes at a low level of health literacy (Moran et al., 2016).

Another study from the same year, Kline et al. (2016), evaluated the effect of incorporating culturally appropriate content in an entertainment-education program designed for Hispanic audiences. The program includes interactive videos where the user can select from different characters and storylines. Social cognitive theory emphasizes that people learn best from role models whose behavior they can emulate, thus the Kline study sought to modify entertainment-educational content to include culturally sensitive

characters and storyline adaptations. In their results, the study participants who watched the culturally appropriate content reported that they identified more strongly with the characters or situations depicted and they were more likely to say that the behavior recommendations could work for them. Adaptations included “color, images, appearance familiar to Hispanic populations,” as well as storylines that incorporated family-centered themes (Kline et al., 2016). This study demonstrated that having culturally appropriate content proves to be more engaging with Hispanic audiences.

In a more recent study performed with the Spanish-speaking television channel Univision, Chattoo, et al., (2020) examined three different storytelling approaches and how engaging they were for Hispanic caregivers about early childhood development. The Univision television network produced and aired content to educate Hispanic caregivers about early brain developments for children ages 0-5. The three different storylines were: a reality show, a scripted drama, and a news program. The study results show that entertainment-education can be an effective way encourage knowledge and intended behaviors. While all three storylines outperformed the control, overall, the drama storyline had the strongest effect across all measurements. Chattoo et al. explain how this type of entertainment-education content is effective in helping individuals acquire knowledge because the audience engages in observational learning. This paradigm describes that audiences are persuaded by the content because they identify with the characters and are absorbed in the story through narrative transportation (Chattoo et al., 2020).

Second, we will explore the graphic content format. In their study, Gaissmaier et al. (2012), tried to find out if patients were able to improve their understanding of health-related statistical information if it was presented in a graphical form compared to a numerical form. The study looked at two things: the impact of the iconicity level on understanding and recall, and the difference in understanding of and preference for graphical compared to numerical information. According to Gaissmaier et al., “iconicity refers to how much a representation resembles what it is supposed to represent versus the extent to which it is an abstraction.” Numbers have low iconicity because they are strong

abstraction of what they represent. Graphics can have varying levels of iconicity, and the highest levels can depict very realistically what they represent. Number or low iconicity representations have the advantage of reducing the information to only the essential elements, eliminating any distracting features. In this aspect, low iconicity allows for a better assessment of detailed-level information, or what Gaissmaier refers to as verbatim knowledge. On the other hand, graphical or high iconicity representations are better for the comprehension of gross-level information, or gist knowledge. Gross-level information refers to the relations between quantities without specifying the difference, for example, one quantity is bigger than another without indicating exactly by how much. Another advantage of high iconicity is that it can make it easier to recall information because pictorial information is more memorable than low iconicity information, like numbers (Gaissmaier et al., 2012).

In a more recent study, Agley et al. (2021), looked at how infographics can be used to improve trust in science. Five different types of infographics were examined by the study participants. To assess the participants' understanding of the intent of each infographic, participants were asked to describe the message that they thought the infographic was trying to communicate. Out of the total sample, 75% of participants had a description that was consistent with the message the authors intended to reflect. For the other 25% of participants whose responses were marked as inconsistent the reasoning for it ranged from participants focusing too much on the image itself rather than the message to participants applying a context outside of the intended message. Additionally, participants were also asked to score the infographics on how believable they view them as. All the infographics scored generally good on the narrative believability (Agley et al., 2021). This study results show that infographics are a trustworthy way to present scientific information.

In a COVID-19 related infographics study, Egan et al. (2021), evaluated the effect of infographics on public recall, sentiment and willingness to use face masks in adult UK population. Participants were asked to evaluate one of five mask guidelines information. There were four infographics from European Centre for Disease Control (EUCDC),

World Health Organization (WHO), Singaporean Ministry of Health (SMOH), and the Behavioral Insights Team (BIT). Participants also evaluated web text from the UK government (UK Gov). This study was able to show that across different measurements - like ability to recall the information, sentiment about the content presented, and willingness to wear a mask - the four infographics scored consistently higher than the text only information provided by the UK government. The study concludes that the use of infographics improved health information transfer and knowledge (Egan et al., 2021).

Lastly, for this study, the format tested that used mainly text-based information was the SMS system. In the past, SMS systems have been used successfully in various health improvement campaigns around the world. A study by Priya, et al. (2014) assessed the perception of receiving health related information through SMS for individuals living in rural India. Their results show that 64% of participants found it useful to receive health-related messages on their mobile phones. Using an SMS system to deliver information is beneficial for people that do not have access to the Internet (Priya et al., 2014).

In a U.S. study, Le et al. (2016) reported on the feasibility and acceptability of using SMS text messages an intervention method complementary to a health workshop for prostate cancer prevention in African American men. The workshop consisted of four in-person meetings and the reception of SMS text messages before and after the meetings. The text messages content was based on the Health Belief Model, which addresses barriers, benefits, efficacy, and threats. The content was developed in an iterative process involving an advisory panel, community partners, and focus groups. The results of this study show that 78% of participants enrolled in the text messaging option of the workshop, 58.8% agreed that the SMS component made the program better, and over 60% of participants indicated that they wished to receive text messages even after they completed the program. The study concluded that using SMS as a method to promote health-related interventions is both feasible and acceptable (Le et al., 2016).

In a more recent study, Evans et al. (2021) also investigated the feasibility and acceptability of receiving health educational information over an SMS system. The study

was informed by the Theory of Planned Behavior, which looks at beliefs (social & normative), attitudes, perceived control (barriers & efficacy), and behavioral intentions. This sought to determine if an SMS system was suitable to deliver health educational information to low-income parents of young children. Participants received a pre- and post-study survey to access any changes in the planned behavior constructs and to collect program feedback. The study results show that using SMS-based interventions can simplify delivery of health education information to low-income parents of young children. The post-study survey showed that retention was high and feedback was largely positive (Evans et al., 2021).

Moreover, Rever et al. (2015) looked at the conditions and situations when public health agencies would utilize bi-directional SMS messaging to disseminate time-sensitive health information. The study identified the benefits of SMS systems as the following: in an emergency the SMS system is more reliable and stable, the costs to public health agencies for receiving messages can be lower, and it can be used as a mass communication tool to obtain “eyes on the ground” information. Some of the biggest challenges identified are: limited screen space, limited character length, uncertainty if the phone number is personal rather than a business, and the difficulty of tracking replies. The study interviewed only health care providers and while it found that most participants preferred email as a way to receive public health alerts, it also found that the preference of the channel of communication was associated with prior exposure to that channel. In other words, the results might be biased because participants have not had extensive prior experience with receiving health information through SMS (Rever et al., 2015).

Health Literacy Impact on Vaccination Campaigns

Vaccines are one of the most successful and cost-effective public health interventions, because they prevent illness, save lives, reduce household health expenses, and improve childhood development (Obi-Jeff et al., 2021). In the past, there have been many successful vaccination campaigns targeting low-literacy people.

In their study, Obi-Jeff et al. (2021), designed an Immunization Reminder and Information SMS System (IRISS) to educate and remind individuals about their immunizations in the Argungu and Fakai communities of northern Nigeria. The low vaccination rates in those communities were attributed to a lack of awareness about the importance of vaccination. The SMS system was selected as the method of delivering vaccination information because previous studies showed success rates in using mobile phones to easily disseminate information to hard-to-reach communities. The study combined focus group discussion to gather data on social norms about vaccination and willingness to use an SMS system. Additionally, a pilot study with the SMS system ran for one year followed by in-depth interviews. Participants in the pilot study were community leaders that were able to share the vaccination information to additional community members. In conclusion, this study showed that involving trusted and respected community leaders in the endorsement of vaccination information had a positive impact on vaccine acceptability (Obi-Jeff et al., 2021).

In a previous study with very similar goals, Wilson et al. (2008), looked at the relationship between health literacy and the ability to understand and communicate vaccination information. The study used a teach-back procedure to provide the nursing intervention necessary to promote patient self-care. Teach-back refers to the process of sharing information with someone and asking them to repeat back what they understood. This procedure has been suggested by several experts as the most beneficial method for health professionals to share health information with patients and ensure that they understood it and are able to take the appropriate actions to improve their health. The study showed how the teach-back procedure was effective in increasing patients' knowledge about the risks and benefits of vaccines (Wilson et al., 2008).

In later study, Kazi and Jafri (2016), described the successful ways in which the Global Polio Eradication Initiative has used mobile phones to increase the vaccination rates around the world. The researchers describe the following effective methods to remind individuals to get the vaccine or to get informed: playing a catchy jingle or ringtone during immunization campaigns, providing interactive voice responses for low

literacy populations, text messages in local languages, messages with graphical images, and using the mobile phone's GPS data to create electronic records of immunizations in a central database to be used by community health workers (Kazi & Jafri, 2016).

In another study published the same year and aimed at Hispanic individuals, Brueggmann et al. (2016), assessed the clarity of health information related to HPV vaccines for Hispanic parents, determined acceptance levels of vaccination, and identified predictors of actual vaccine acceptance. For participants that understood all or most of the information, 81% were willing to vaccinate their children. In comparison, of the participants that understood little or none of the information, only 57% were willing to vaccinate their children. In addition, levels of prior knowledge were not a significant factor in willingness to vaccinate. The major barriers reported as reasons against vaccination acceptance were lack of knowledge about vaccine benefits, about the efficacy of the vaccine, and about the optimal time to be vaccinated. The researchers crafted the health educational material based on the Theory of Planned Behavior, which will be discussed in detail in the next section. In the context of the Brueggmann et al. study, the participants' acceptance of vaccines was established as a necessary step to vaccination. Thus, the researchers hypothesized that if they can positively affect a parent's attitude towards the vaccine, then this will be a predictor of the intention to vaccine their children. Subsequently, if the parents establish an intention to vaccinate their children, they are more likely to do it (Brueggmann et al., 2016).

Behavior Modification Theories

Several studies in this literature review were designed using the Theory of Planned Behavior and the Health Belief Model (Brueggmann et al., 2016; Evans et al., 2021; Le et al., 2016; Obi-Jeff et al., 2021). The Theory of Planned Behavior was introduced in 1985 by Icek Ajzen. It is guided by three considerations: beliefs about the consequences of a behavior, beliefs about the expectations of others, and beliefs about the ability to perform a behavior. Consequently, these three different beliefs produce: personal attitudes, societal norms, and self-efficacy. The Theory of Planned Behavior

produces the general rule that the more favorable the personal attitude and societal norm, and the greater the perceived self-efficacy, then the stronger the person's intention will be to perform the behavior. This theory assumes that intention is the antecedent to behavior (Bosnjak et al., 2020). Based on the Theory of Planned Behavior, this study hypothesizes that if the researcher can change the participants' attitude towards the intention of getting the COVID-19 vaccine, then the participants would be more likely to get the vaccine.

The Health Belief Model was introduced in 1974, but it is based on social psychological theories from the 1950's. The model is based on a behavior theory model which states that a behavior is dependent on two variables: the value placed on a particular goal, and the estimated likelihood that a given action will achieve that goal. Thus, in the context of health, the Health Belief Model states that an individual's health-related behavior depends on the desire to avoid illness (or if ill, to get well), and the estimated likelihood that a specific health action will prevent (or reduce) the illness. In addition to an individual's beliefs, there must also be a stimulus that will trigger the appropriate health behavior. The stimulus can be either internal or external. An example of an internal stimulus is an individual's experienced symptoms. Some examples of external stimuli are mass media communications, interpersonal interactions, or reminders from healthcare providers (Maiman & Becker, 1974; Janz & Becker, 1984). Based on the Health Belief Model, another hypothesis can be made that the exposure to the health educational material covered in this study could: (1) positively influence participants perception that getting the COVID-19 vaccine will reduce the severity of the symptoms if the individual becomes ill with COVID-19, and (2) provide the necessary external stimulus to trigger getting the vaccine. However, this study focuses only on understanding the preferences in format for consuming vaccine information; it is not designed to measure or influence the participants' desire to avoid becoming ill with COVID-19.

Health Literacy Studies Related to COVID-19

There are a few studies completed on the current COVID-19 emergency regarding people's perception of the pandemic and their acceptance of the COVID-19 vaccine.

Hermans et al. (2021) assessed the association of health literacy with mental health, compliance with preventive measures, and personal health prospects in Belgium. Their study shows that health literacy is a crucial factor in managing the COVID-19 epidemic. “People with low levels of health literacy are less likely to comply with preventative behavioral measures,” report more mental health problems, and have a more negative perspective of their future health. Taking the audience health literacy into account when communicating COVID-19 information means adapting the type and amount of information to the intended audience, clarifying that new evidence on the virus can emerge which may lead to modifying public recommendations, transparently communicating new information on the virus, and correcting earlier messages. Another factor of communication COVID-19 information is countering false or misleading information. This can be achieved by encouraging people to cross-check source accuracy and credibility, to consult trusted health professionals, and to not share information that has not been fact-checked (Hermans et al., 2021). The conclusions of the Hermans et al. study have informed the researcher that the health education material produced for this study should include a disclaimer that information regarding the COVID-19 vaccine can change as additional data emerges, and a reference to how to check a source’s trustworthiness.

Nur Karabela et al. (2021) investigated the connections between a person’s perception about the cause of the COVID-19 pandemic, their attitude towards getting the COVID vaccine and their level of trust in information sources about the pandemic. The study was conducted with participants from various regions in Turkey. Their results show that 54% of the participants thought about getting vaccinated, 16% did not want to get vaccinated, and 30% were undecided. For participants that stated they would get vaccinated, their source of most trusted information was YouTube, for participants that did not want to get vaccinated it was WhatsApp groups, and for undecided participants it was social media, like Facebook, Twitter, and Instagram. The study also shows that the level of trust individuals had in government institutions and health authorities had a direct correlation with the level of vaccine resistance. People that trust government and health

experts are more likely to take the COVID-19 vaccine and are also less likely to trust social media (Nur Karabela et al., 2021). The conclusions drawn from the Nur Karabela, et al., study, have informed the researcher that people are seeking COVID-related health information on mobile and mass media channels. Thus, the decision to explore less-traditional means of disseminating health-related information - like text messaging, videos, and infographics – is well-suited to the way that people have sought information during this pandemic.

Literature Review Conclusion

Studies show that people with low literacy have low health literacy. This has a direct impact on how they view the current risks associated with the COVID-19 pandemic as well as the decision to get vaccinated. A solution to vaccination hesitancy is improved information sharing about the risks of the disease and benefits of the vaccine. One way to improve the way information is shared is to ensure the audience receives the information in the format that is most engaging to them. Consequently, because some people prefer one format over another, multiple formats should be used to propagate the information. Great care should be taken when designing the information to ensure it is appropriate for the target audience, and the advantages and disadvantages of each format should be thoroughly understood.

For this study, the researcher chose to use the co-creation method to develop the health education material because this collaborative design method has been proven by multiple studies to be a successful way to create content in Spanish for a Spanish-speaking audience (Ginossar & Nelson, 2007; Pagán-Ortiz & Cortés, 2021). The success of this method can be attributed to the ability of the co-designers to address cultural norms or language nuances that might be unfamiliar to someone that does not speak Spanish or is not of Hispanic origin.

For the methods to communicate the health-related information, the researcher chose the following formats to communicate information at a lower literacy level: short conversational-style text messages, infographics that can depict statistical information as

pictograms, and videos with a narrative storyline. These formats were selected because of the way each format takes advantage of the way the human brain functions.

The SMS system was selected because of this medium's ability to break up the content in small chunks that could be presented progressively as the user requests to see more information. Our understanding of human working memory supports this use of chunking. Psychology informs us that working memory is limited to 3-5 items that we can focus our attention on, thus user-interface guidelines recommend sharing only a few items at time to decrease the cognitive load on working memory (Johnson, 2014). Decreasing cognitive load allows the reader to process and understand the information more thoroughly.

Infographics were selected because of this medium's ability to utilize visual elements to draw attention and to explain concepts. Our human brain is wired to be able to recognize information and patterns from visual cues. It is much harder to try to recall information, understand complex concepts, or perform calculations (Johnson, 2014). Infographics are designed to present complex ideas with visual elements that can take advantage of our brains' ability to recognize patterns. Additionally, information connected to visual elements in infographics can activate emotions, which can strengthen recall for the information in the future.

Lastly, videos with narrative plots were selected for this study because of this medium's ability to utilize storytelling to communicate information. Because stories combine information, context, and emotion together, they can be used to facilitate recall and affect behavior. When people are told stories, they are more likely to be willing to act on the information than if they are just presented data (Weinschenk, 2013).

Chapter 3: Research Methodology

Research Goal

The goal of this study is to co-design health education material that could aid in the uptake of COVID-19 vaccination rates among the Spanish-speaking population, by focusing on improving the engagement of low-literacy individuals. The study explored different formats for engaging with low-literacy individuals: through an SMS bi-directional conversation chat bot system, through infographics, and through a series of short videos.

Research Questions

The study aimed to answer the following questions:

- Which format is most and least preferred? And why?
- Does the material improve the knowledge of the participants related to COVID-19 vaccines?

Participants

Two types of participants were recruited for this study: one group served as the co-creators of health educational material ($n = 3$) and another group as the tests that evaluated the effectiveness of the material ($n = 6$).

The co-creator participants were community members that served in various leadership, academic, and professional positions in a majority Spanish-speaking community in Northern Virginia. All co-creators were bilingual and had a college-level education. They were recruited by word of mouth using connections with the researcher.

The test participants were community members from the same Spanish-speaking community. They were recruited by flyers placed in churches, grocery stores, and community centers. These participants were tested to assess their literacy level, using the

Short Assessment of Health Literacy – Spanish, described below. In addition, socioeconomic and demographic information was collected for each test participant.

Procedure

The study used focus groups with the co-creator participants to develop the health educational material through an iterative design process. The test participants attended individual user interviews to test the effectiveness of the material.

First, an initial draft of all health educational material was created by the researcher in English and in Spanish. This included: question-response messages for the SMS system, script for three videos, and low-fidelity prototypes for three infographics. All COVID-19 vaccine information used in the health educational material was collected from the website of the Centers for Disease Control and Prevention.

For the first stage of the study, a focus group was organized for the co-creator participants to amend the drafts created by the researcher and to validate the Spanish translation. The researcher presented the co-creators with instructions about each mode of information with context-appropriate examples. The focus group was conducted in English, while the materials were worked on in Spanish. The co-creators verified the content of language correctness and cultural appropriateness.

For the second stage of the study, individual user interviews were conducted with test participants. First, participants were tested on their health literacy using the *Short Assessment of Health Literacy-Spanish*, or SAHL-S. This test instrument was created by Lee, et al., (2010) to assess a Spanish-speaking adult's ability to read and understand common medical terms. SAHL-S has been validated against the *Short Assessment of Health Literacy for Spanish-speaking Adults* (SAHLSA) and the Spanish version of *Test of Functional Health Literacy in Adults* (TOFHLA). Both SAHLSA and TOFHLA are focused on assessing an adult's readying ability in a health context using 50 test items, and these tests usually take around 20 minutes to administer. SAHL-S was found to be comparable in assessing a Spanish-speaking adult's health literacy with SAHLSA and Spanish TOFHLA (Lee et al., 2010). SAHL-S was selected as the test instrument for this

study because it is comprised of only 18 test items, it is easy to administer, and can be completed in less than five minutes.

Next, participants were tested on their existing knowledge of the COVID-19 vaccine using the pre-session questions. The researcher then guided the participants through the material of the three different prototypes. After reviewing the prototypes, the participants were asked the post-session questions. The pre- and post-session questions were similar in context but were worded differently and presented in a different order. This was done to prevent the participants simply recalling their previous answers. The aim of the pre- and post-session questions was to observe if reviewing the prototype material improved the participants knowledge of the COVID-19 vaccine. The pre- and post-session questions can be found in Appendix D.

Lastly, the participants' feedback was recorded, and the prototype material was annotated with the suggested improvements. In addition, the researcher recorded the participants' preference for the mode of delivery of information. Participants were also asked why they preferred one format over the others.

Chapter 4: Results

Focus Group with Co-Creator Participants

The study was conducted for 6 weeks during the month of February and March of 2022. First, the focus group yielded valuable feedback for the educational material based on the initial drafts that the researcher created. For the SMS system messages, the co-creator participants revised the order the information was revealed in and how detailed each message should be. The co-creators suggested that after reviewing the ingredients of the COVID-19 vaccine and how the body builds immunity using the vaccine, the next series of messages should explain why someone should get vaccinated and all the additional shots that might be needed. In addition to this existing information, one co-creator recommended to have a series of messages on who qualifies to get the COVID-19 vaccine. This co-creator supported this suggestion with their experience in working as an ESOL adult educator, saying that: “Many of my students are immigrants and they think that you must be a U.S. citizen to get the vaccine. I had to explain to them that anyone residing in the U.S. can get the vaccine regardless of their immigration status.” This recommendation was used to create an additional option in the SMS system menu.

Furthermore, another co-creator recommended expanding the final message of each series from “Do you want to learn more?” to “Do you want to learn more about …?” The recommendation was that each final message in the series should include a description of what the information in the next series will be about. Having such a description permits the user to make a more informed decision about whether they would like to receive additional messages, if they would like to return to the main menu, or if they would like to end the interaction with the SMS system. The entire SMS system message transcript can be found in Appendix A.

For the infographics, the co-creators revised the content of three low-fidelity infographics the researcher created before the focus group. The co-creators suggested several grammar corrections and added descriptive titles for each infographic based on the main audience for the infographic. For example, for an infographic related to

COVID-19 vaccine information for children and pregnant women, the co-creators suggested a title of “The COVID-19 vaccine and your family.” This title better reflected the emphasis that the Hispanic culture places on the family. During the focus group session, the researcher started creating high-fidelity prototypes and reviewed them with the co-creators to ensure readable color contrast and page layout. A sample of the low-fidelity and high-fidelity infographics can be found in Appendix B.

For the video scripts, the co-creators revised the content and performed a short role-play exercise to ensure that the conversation was natural and believable. For example, for the video script involving a pediatrician and a parent, two co-creators role-played the two characters to review the flow of the conversation. The co-creator playing the doctor felt that the doctor character should listen more to the parent character and allow that character to voice their concerns with getting the vaccine. This recommendation was made to ensure that both characters get equal speaking time and that the interaction between a physician and an average person appears more balanced, and that the physician shows respect for the patient. The third co-creator watched this role-play and recommended to have the doctor character include a brief explanation that vaccinating a child against COVID-19 protects their family members and other children at school. The co-creator said: “A lot of this material focuses on one person’s individual choice, but getting a vaccine is also about protecting the people around you. So it would help to send a message that getting vaccinated is not just about the individual but it is important for the well-being of the community.” This recommendation was used to amend the script because it appealed to family and community, a strong influencing theme in the Hispanic community. After the focus group, the researcher created high-fidelity prototypes of the videos using stock video and voice-over recordings. All three video scripts and high-fidelity prototype screenshots can be found in Appendix C.

Lastly, all the material was revised by an academic advisor specializing in creating information for low-literacy users. Several modifications were made to simplify and improve sentence structure. Simplifying the content and making it easier to read reduces the demands on working memory, which in turn makes it easier to process and

understand the information. This step ensured that the content in the study material was appropriate for readers with low literacy levels. Additionally, content designed for low-literacy readers makes it easier for readers of all levels to consume the information (Summers & Summers, 2005).

Individual Interviews with Test Participants

After the educational material was finalized, it was presented to the test participants in individual interviews. Interviews were conducted virtually using Zoom. The researcher provided instructions in Spanish to the test participants. All the questions and the educational material was presented in Spanish as well. The researcher simulated the SMS system by sending text and image messages to the participants using either Google Voice in the browser or WhatsApp on desktop. The participants were instructed to use their phones to interact with the SMS system. The participants received these messages either as messages using the WhatsApp phone application or text messages using their cellphone provider. For the infographics and videos, the researcher asked the participants to review the content using their own computer and they accessed it using links provided to them during the Zoom session.

Overall, six test participants were recruited, four females and two males. Their ages ranged from 36 to 48, with one participant being 75 years old. Only one participant scored low on the health literacy test, another participant scored medium, and four participants scored high on the health literacy test. The aim of the health literacy test was to assess the participants overall literacy with health-related information and to observe if there is a difference in how the material is consumed or a preference in format. It was not possible, due to the pandemic, to recruit additional participants with low health literacy.

The pre- and post-session questions were used to evaluate the participants knowledge before reviewing the educational material and after reviewing it. The aim of this evaluation was to observe if there is a change in the answers and if it could be inferred that that change was caused by the educational material. Five questions were asked in both questionnaires and while the questions were the same five questions, they

were slightly reworded to avoid recency effect. An answer was marked as improved if the participants either corrected their answer in the post-session questionnaire or if they provided additional details that related to the information they reviewed in the educational material. The pre- and post-session questions can be found in Appendix D.

Table 1

Comparing Pre- and Post-Session COVID-19 Vaccine Knowledge

	Health literacy score	Did the participant answer the pre-session questions correctly?	% of correct answers for pre-session test	Did the participant answer the post-session questions correctly?	% of correct answers for post-session test	Did the participant improve their answers?
Participant 1	High	Q1 – partial correct Q2 – correct Q3 – correct Q4 – correct Q5 – correct	80%	Q1 – partial correct Q2 – correct Q3 – correct Q4 – correct Q5 – correct	80%	Q1 – no improvement Q2 – no improvement Q3 – improvement Q4 – no improvement Q5 – improvement
Participant 2	High	Q1 – incomplete Q2 – correct Q3 – correct Q4 – correct Q5 – incorrect	60%	Q1 – partial correct Q2 – correct Q3 – correct Q4 – correct Q5 – incomplete	60%	Q1 – improvement Q2 – no improvement Q3 – no improvement Q4 – no improvement Q5 – no improvement
Participant 3	Low	Q1 – incomplete Q2 – correct Q3 – incorrect Q4 – correct Q5 – incorrect	40%	Q1 – correct Q2 – correct Q3 – correct Q4 – correct Q5 – partial correct	80%	Q1 – improvement Q2 – no improvement Q3 – improvement Q4 – no improvement Q5 – improvement
Participant 4	High	Q1 – correct Q2 – correct Q3 – partial correct Q4 – incorrect Q5 – correct	60%	Q1 – correct Q2 – correct Q3 – correct Q4 – correct Q5 – correct	100%	Q1 – no improvement Q2 – no improvement Q3 – improvement Q4 – improvement Q5 – no improvement
Participant 5	High	Q1 – correct Q2 – correct Q3 – correct Q4 – correct Q5 – correct	100%	Q1 – correct Q2 – correct Q3 – correct Q4 – correct Q5 – incorrect	80%	Q1 – no improvement Q2 – no improvement Q3 – no improvement Q4 – no improvement Q5 – no improvement
Participant 6	High	Q1 – partial correct Q2 – correct Q3 – incorrect Q4 – no answer Q5 – partial correct	20%	Q1 – partial correct Q2 – correct Q3 – correct Q4 – correct Q5 – incorrect	60%	Q1 – no improvement Q2 – no improvement Q3 – improvement Q4 – improvement Q5 – no improvement

For the question asking if the person knows how the COVID -19 vaccines create immunity in the body, two participants improved their answers after reviewing the educational material, while the others stayed consistent. For the question asking if and why a person that was sick with COVID-19 and is not vaccinated could become sick with COVID-19 again, one participant changed their answer from the correct ‘yes’ to an

incorrect ‘no’. For the question asking about the possible side effects of the COVID-19 vaccine, half of the answers improved while the other half stayed the same in their level of detail. For the question asking if the COVID-19 vaccine can infect someone with the COVID-19 virus, four participants answered correctly before reviewing the educational material, one said that they do not know, and another participant gave an answer that could not be interpreted as either yes or no. After reviewing the material all participants answered this question correctly. For the question asking who can receive the COVID-19 vaccine, in the pre-session, half of the participants correctly answered “everyone over 5 years old” while the rest said “everyone”. In the post-session questionnaire, only two participants stayed consistent and kept their answers as “everyone over 5 years old”, two participants gave more detailed answers but still answered essentially that everyone can take the COVID-19 vaccine, and two participants seemed to have misinterpreted the question as “who can give the vaccine” and “where can you receive the vaccine.”

Reviewing participants preferences for the three different formats, the video was the format selected as most preferred, followed by the SMS system, and lastly the infographics. The participants that preferred the video said they liked this format more because it was easier to understand and recall the information; in addition, the audio-visual format is more convincing. The participants that preferred the SMS system said they liked it because it “more interactive and less alarmist than the [other] two” and that it allowed them to select what information they wanted to learn about.

When participants were asked to select which format they liked least, the answered were split evenly among the three formats. When asked to explain why the participant like a format least, their answers were that the SMS and infographics provided too much to read and were “less entertaining,” while the participants that disliked the videos said that they felt that the videos tried too hard to convince the audience to think a certain way. Table 2 summarizes these results. Note that participants’ direct comments are translated as-is from Spanish to English.

Table 2

Comparing Most Preferred and Least Preferred Formats

	Most preferred format?	Why?	Least preferred format?	Why?
Participant 1	Video	“It is a little easier and I think it has more recall”	SMS	“The message is a bit long and requires more time”
Participant 2	Video	“Because the audio visual is more complete and convincing”	SMS	“It is less entertaining to receive information”
Participant 3	Video	“Clearer everything, and it is more understandable”	Infographic	“a lot of reading”
Participant 4	SMS	“It felt more interactive and less alarmist than the two later ones”	Video	“In my personal opinion, I believe that acquiring the vaccine or not is a personal decision and even though the information in the videos is true, I felt strong pressure to try to convince.”
Participant 5	SMS	“Because it allows me to interact with the messages. It makes me feel like I can choose what information I want to get and what I don't want to get”	Infographic	“It is easy to find the same information in other sources of information”
Participant 6	Infographic	“Inform me a lot about the vaccine and the covid 19 virus”	Video	“Because the video is made to inform people who do not believe in the vaccine”

Chapter 5: Discussion

This study aligns with other co-designing studies that show that the method of co-designing study prototypes generates helpful improvements (Ginossar & Nelson, 2007; Pagán-Ortiz & Cortés, 2021). When multiple people of diverse backgrounds and with different lived experiences contribute to the creation of content, the final product can address the needs of a wider and more diverse audience. Additionally, the results from the focus group show that this method works especially well when designing content in another language and for another culture. Simply translating the content from English to Spanish was not enough. Having three native Spanish speakers reviewing the translation and providing idiomatic and cultural corrections proved essential to creating prototypes that were believable and trusted by the test participants. Ensuring a sense of trust in the information that was presented to the test participants was especially important to this study because the information was health related. From the literature review, it was concluded that engaging health-related information can have an impact on the health outcomes of the participants. Therefore, this study aimed to provide accurate COVID-19 vaccination information and to ensure that the test participants were confident in the information's authenticity because it was tailored to their language needs.

In addition to co-designing educational material using a focus group, the study tested that material with a new set of participants to try to answer the following questions:

- Which format is most and least preferred? And why?
- Does the material improve the knowledge of the participants related to COVID-19 vaccines?

To answer the first question, the results show that the video format was the most preferred because it was easier to understand and recall the information. Based on the participants' feedback, the video format was perceived to be the most "convincing." The researcher concluded that the word "convincing" was used in the sense of "having the intention to persuade." This word was used both in the explanation why the video format

was most preferred as well as why it was least preferred. It can be inferred from this feedback that having health information presented in an audio-video format can be perceived as being more explicitly persuasive than the SMS or infographic formats. The SMS and infographic formats were perceived as being less persuasive mediums of providing information, while the video format was perceived as being more active in trying to change the opinion of the audience about the COVID-19 vaccine.

Preference for the videos is consistent with the body of evidence that shows narrative style visual and audio content to elicit a more meaningful emotional response from audiences. By telling a story that the audience can relate to, the video format was able to create stronger emotional connections with the information communicated. This is possibly why the participants said in their feedback that the video format made it easier to understand the information and easier to recall.

Next, the study results show that the SMS system was the second most preferred format because of the progressive nature that information is revealed to the participant. The participant was in control of how little or how much information they wanted to have displayed to them. Moreover, they were able to select what information they wanted to interact with. This format allowed the participants to view the information in the order that they individually preferred and based on whatever previous knowledge they already had related to the COVID-19 vaccines. In contrast, the participants had to watch the videos in their entirety to learn if the information they presented was new to them. While the video format is a more entertaining medium, the SMS system provided participants with greater control over the information they wanted to acquire.

It is speculated that the SMS system format was preferred over the infographic format because designing the interaction between the user and the content as a conversation gives the user a sense of comfort and it is less intimidating. Simulating a back-and-forth conversation that provides short chunks of information eases the cognitive load on working memory. Additionally, giving the user the control to select the information they would like to learn about and to read at their own pace provides the user

with confidence in their knowledge acquisition. Allowing the user to feel comforted and confident increases their positive emotional interaction with the system.

Contrasting conclusions can be drawn about the infographic format. Only one participant selected this format as their preferred one, and two participants said that this format offered too much information to read. It can be understood why this format was the least preferred format, given that it provides the information all at once and there is no real interaction with the content. While the infographics presented information both textually and visually, through the forms of graphs and icons, the lack of active interaction with the content proved to be less appealing to participants.

To answer the second question of “Does the material improve the knowledge of the participants related to COVID-19 vaccines?”, Table 1 shows the percentage of questions that are answered correct in the pre- and post-session questionnaires. The results show that:

- two participants had no change in the number of correct answers
- three participants had an improvement of 20% – 40% of correct answers after reviewing the material
- one participant went from 100% correct answers to 80% correct answers, possibly because of confusion over how one of the questions was re-worded in the post-session questionnaire

Given the small number of participants in the study, it cannot be concluded that the improvement in COVID-19 vaccine knowledge of participants is statistically significant. However, it was encouraging to note that half of the participants learned something new from the study material which they were then able to recall at the end of the study session.

Chapter 6: Conclusion

This study aimed to co-design health education material that could aid in the uptake of COVID-19 vaccination rates among the Spanish-speaking population, by focusing on improving the engagement of individuals with low health literacy. The study explored different formats of engaging with these individuals: through an SMS bi-directional conversation chat bot system, through infographics, and through a series of short videos.

The study showed that when designing for a Spanish-speaking audience, it is imperative to have native Spanish-speaking individuals in the group of designers. A simple dictionary translation of the content is not enough to create high-quality and credible health educational material. This study adds to the body of evidence that co-designing using a focus group of culture-qualified co-creators can create quality educational material in a short period of time.

While this study is not able to conclude definitively if one format is more engaging than the rest, the qualitative results show why each format is preferred and what were the participants' perceptions of each format. Half of the participants selected the video format as the most preferred one, but this format was perceived as being more active in trying to persuade the participants' opinions. The SMS system was selected as the second-most preferred format because it both gave participants more control over the information they received and presented the information at the reading pace of the individual participant. The infographics were selected as the least preferred format because they presented the information all at once, which proved to be off-putting and tiresome to read for some participants.

In conclusion, the information produced from this study could be used to create COVID-19 vaccination information for Spanish-speakers in different formats, in addition to the mainly text-based web pages already available on the website of the Centers for Disease Control and Prevention. Providing health information in multiple formats can be helpful when Spanish-speakers like to engage with different forms of content. This

approach is likely to ensure that more Spanish-speakers will access accurate health information that could then have a positive impact on their health outcomes.

Limitations

One limitation of the study was the small number of test participants that were recruited during the allotted time. Because of this small number, there is not enough variation in the sample size of the results. The gender spread is not evenly split, and no participants were excluded from the analysis because they tested high on the health literacy test. The aim of the study was to look at how engaging the material was for low health literacy users; however, because of the low participant pool the results from participants with both high and low literacy were analyzed.

Another limitation of the study was using open answer questions to test the participants knowledge of the COVID-19 vaccine before and after they reviewed the educational material. Some questions were answered vaguely and there was insufficient indication to determine if the participant knew the answer or not. For example, one participant answered the question “Can the COVID-19 vaccine infect you with the COVID-19 virus?” with: “Personally, in my family there were two cases in which the virus was unleashed in their body after the vaccine, however it is an idea or presumption without scientific verification.” A possible improvement to this evaluation would be to format the questions with multiple choice answers. This would provide a clear indication if the participants changed their answers to mark an improvement and it would eliminate any vague answers that could not be interpreted.

One aspect this study was not able to do was to show which of the formats are most effective in increasing information comprehension and retention. The health information presented in all formats overlapped and so some information was presented several times as the participants reviewed all three formats during the same study interview session. An improvement to the study could be for each format to present completely different information. Thus, by reviewing the pre- and post-session answers it

could be deduced which format was more effective if the answers reflect the knowledge gained from a particular format.

Next Steps

This study adds to the body of evidence that even well-designed infographics are likely to be inadequate in generating engagement with the information. If infographics are the only medium used to communicate information in addition to traditional webpages, then other helpful tools are being left unused. To properly disseminate information to a diverse population, multiple non-traditional formats should be employed. Specifically, the results of this study show that there should be more investment in SMS systems and video content. These tools can effectively chunk information and use storytelling to make it easier to create behavior changes in the community.

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Appendix A: SMS System Message Transcript

“Hi! We’d like to share information about the COVID-19 vaccines. This is an automated messaging system. Select from the following options to get started.”

“Reply with the number corresponding to the option below.”

- 1 – Learn about the ingredients of the COVID-19 vaccines
- 2 – Learn about how your body builds immunity using vaccines
- 3 – Learn about why and when you should get vaccinated
- 4 – Learn about who qualifies to get the vaccine
- 5 – Show me locations where I can get the COVID-19 vaccine
- 6 – Set up a reminder to get vaccinated”

---Option 1 message series, part 1---

“Nearly all the ingredients in COVID-19 vaccines are also ingredients in many foods, like fats, sugars, and salts. These ingredients work together to help keep the vaccine molecules stable while the vaccine is manufactured, shipped, and stored.”

“COVID-19 vaccines do NOT contain ingredients like preservatives, tissues (like aborted fetal cells), antibiotics, food proteins (like eggs, gluten, or nuts), medicines, latex, or metals.”

“Do you want to learn more about the different types of COVID-19 vaccines?
Reply YES. Replying NO will take you to the main menu.”

---Researcher makes decision ---

If user inputs NO then reply with main menu message.

If user inputs YES, continue with Option 1 message series part 2.

---Option 1 message series, part 2 ---

“There are two types of COVID-19 vaccines authorized by the FDA in the United States. The Johnson & Johnson COVID-19 vaccine is a traditional vaccine. It contains a harmless version of a virus that is not related to the virus that causes COVID-19. The Pfizer and Moderna COVID-19 vaccines are called messenger RNA (mRNA) vaccines because they contain a molecule similar to DNA. mRNA vaccines are new to the public,

however, researchers have been studying and working with mRNA vaccines for decades.”

“Both traditional and mRNA vaccines give instructions to cells in your body to create an immune response. After the body produces an immune response, it discards all the vaccine ingredients just as it would discard any material that cells no longer need. This process is a part of normal body functioning.”

“Do you want to learn more about how your body’s immune system works?
Reply YES. Replying NO will take you to the main menu.”

---Researcher makes decision ---

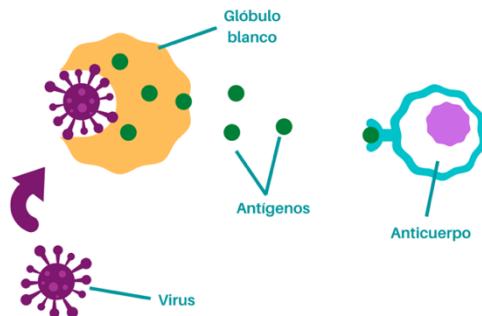
If user inputs NO then reply with main menu message.

If user inputs YES, the continue with Option 2 message series.

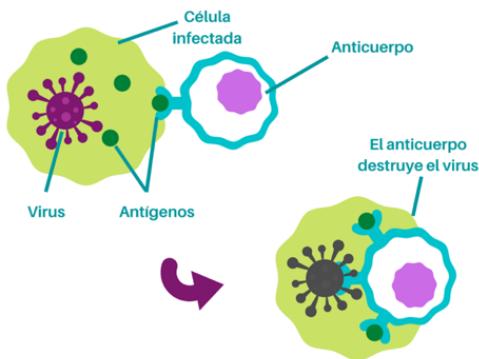
---Option 2 message series, part 1 ---

“To understand how COVID-19 vaccines work, it helps to first look at how our bodies fight illness.”

“When germs, such as bacteria or viruses, enter the body, they attack our cells and multiply. This attack on your cells by the germ is called an infection and it is what causes illness.”



“Our bodies use white blood cells to fight an infection. Some white blood cells swallow up and digest the germ. They leave behind parts of the invading germs called antigens. The body identifies antigens as dangerous and creates antibodies to attack them.”



“The antibodies attack antigens and cells in the body that have already been infected with the germ. Once the germ and all cells that were infected are destroyed, then you are cured from the illness. You are left with antibodies that will remember how to fight that germ in the future.”

“Do you want to learn more about how the vaccines work with our immune system? Reply YES. Replying NO will take you to the main menu.”

---Researcher makes decision ---

If user inputs NO then reply with main menu message.

If user inputs YES, the continue with Option 2 message series, part 2.

---Option 2 message series, part 2 ---

“Vaccines help your immune system to produce antibodies without causing an infection.”

“An ingredient in the vaccine contains the instructions for your cells to create the antigen without having to be infected with the germ. The antigen in the body makes the body create antibodies to attack the germ in the future.”

“It typically takes a few weeks after vaccination for the body to produce the antibodies. Therefore, it is possible that a person could be infected with the virus that causes COVID-19 just before or just after vaccination and then get sick because the vaccine did not have enough time to provide protection.”

“Sometimes after vaccination, the process of building immunity can cause symptoms, such as fever. These symptoms are normal and are signs that the body is building immunity.”

“Do you want to learn more about the benefits of getting the COVID-19 vaccine? Reply YES. Replying NO will take you to the main menu.”

---Researcher makes decision ---

If user inputs NO then reply with main menu message.

If user inputs YES, the continue with Option 3 message series.

---Option 3 message series ---

“Getting a COVID-19 vaccination is a safer and more dependable way to build immunity to COVID-19 than getting sick with COVID-19. The vaccine causes a more predictable immune response than infection with the virus that causes COVID-19.”

“Getting sick with COVID-19 can offer some protection from future illness, sometimes called “natural immunity,” but the level of protection people get from having COVID-19 may vary depending on how mild or severe their illness was, the time since their infection, and their age.”

“One study showed that, for people who already had COVID-19, those who do not get vaccinated after their recovery are more than 2 times as likely to get COVID-19 again than those who get fully vaccinated after their recovery.”

“It is recommended to get vaccinated or get boosted even if you already had COVID-19.”

“Do you want to learn more about who is qualified to receive the COVID-19 vaccine? Reply YES. Replying NO will take you to the main menu.”

---Researcher makes decision ---

If user inputs NO then reply with main menu message.

If user inputs YES, the continue with Option 3 message series.

---Option 4 message series ---

“Everyone living in the United States is qualified to receive the COVID-19 vaccine, regardless of their immigration status. All COVID-19 vaccine initial doses and boosters are free of charge. You do not need a doctor’s note or to have health insurance to receive the COVID-19 vaccine.”

“The Pfizer vaccine and booster is approved for everyone 5 years and older. The Moderna vaccine and booster is approved for everyone 18 years and older. The Johnson & Johnson vaccine is approved for everyone 18 years and older with a Pfizer or Moderna booster.”

“Do you want to learn more about places where you can get the vaccine? Reply YES. Replying NO will take you to the main menu.”

---Researcher makes decision ---

If user inputs NO then reply with main menu message.

If user inputs YES, continue with Option 5 message series.

---Option 5 message series ---

“Reply with your 5-digit zip code to see a list of vaccination locations.”

---Researcher uses the zip code that the user replies as input for vaccines.gov. Below is an example of the first three results for the zip code 20110.

“COVID-19 vaccine locations near 20110:

1.

Walmart Inc #10-3573

Historic District, 9401 Liberia Ave, Manassas, VA 20111

Check appointment availability (vaccines in stock)

0.19 miles

2.

Harris Teeter Pharmacy #09700303

10060 Market Cir, Manassas, VA 20110

COVID-19 appointments available

0.76 miles

3.

Walgreens Co. #11912

Historic District, 9271 Sudley Rd, Manassas, VA 20110

COVID-19 appointments available

0.97 miles”

“For more locations, visit vaccines.gov”

“Do you want to set up a reminder to get the COVID-19 vaccine or booster?

Reply YES. Replying NO will take you to the main menu.”

---Researcher makes decision ---

If user inputs NO then reply with main menu message.

If user inputs YES, the continue with Option 6 message series.

---Option 6 message series ---

“Have you already made an appointment to get the COVID-19 vaccine or booster? Reply YES or NO.”

---Researcher makes decision ---

If user inputs NO then go through Option 5 message series.

If user inputs YES, the continue.

---Option 6 message series continued---

“What is the date of your appointment? Reply with the format MM/DD/YYYY.”

“What is the time of your appointment? Reply with the format HH:MM AM or PM.”

“You have now set a reminder for your next appointment. You will receive a text message reminder 5 days, 1 day, and 2 hours before the appointment.”

“Do you want to set up another reminder? Reply YES. Replying NO will take you to the main menu.”

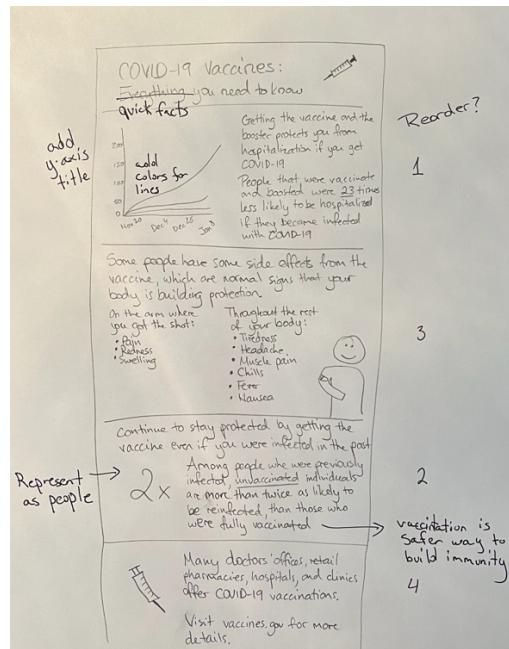
---Researcher makes decision ---

If user inputs NO then reply with main menu message.

If user inputs YES, the continue with Option 6 message series again.

Appendix B: Sample of an Infographic

Low-fidelity prototype:



High-fidelity prototype:



Appendix C: Video Scripts

Video 1 – Friends

Setting description

A young 20 something person talks to another young person about why they do not see the need to get the COVID vaccine because they heard that people are still catching the virus, so they think there is no point in getting the vaccine (they do not see the benefit of it).

Script

Friend 1: Hey, are you free for lunch today? I am on campus and I would like to see you.

Friend 2: I am going to the pharmacy to get the booster. Can we meet in the evening?

Friend 1: Oh ok. Are you talking about the covid vaccine?

Friend 2: Yes. Did you get your booster already?

Friend 1: Oh no. I don't see the point in getting the vaccine. They say on the news that people are still getting the virus even if they're vaccinated, so then what's the point of the vaccine?

Friend 2: Yeah, I see how that can get confusing, but my doctor said that people that are vaccinated and get sick with covid are less likely to be seriously ill. The vaccine doesn't make it so you never get sick with covid, but it does teach your body to build up immunity to the virus. That way when you get sick you have a better chance of fighting it.

Friend 1: Yeah, but if I get it then I'll just ride it out, I guess.

Friend 2: But you have no way of knowing how sick you might get. What if you get sick and need to go to the hospital? For most people, the vaccine keeps them from getting so sick that they need to go to the hospital. I say this because my cousin got covid and she was hospitalized for a month.

Friend 1: Oh no. I'm sorry to hear that.

Friend 2: Yeah, it was really scary. She wasn't vaccinated and she didn't think that she would get that sick because she's young and she never gets sick. I thought the same thing, but after seeing what my cousin went through, I got the vaccine just to be sure I don't get seriously ill. And it was really easy to get it. I got the first two doses of the Pfizer vaccine at my doctor's office in the summer. Now I want to get the booster and I saw that I can do that at the pharmacy around the corner. You should look into it too. It's really easy, you can go online to vaccines.gov and find the nearest location to you that has appointments.

Friend 1: And I don't need a referral from my doctor?

Friend 2: No. And the vaccines are free. You don't need insurance or a note from your doctor.

Friend 1: Ok, you convinced me. I'm looking up locations right now.

END

Stock video screenshot



Video 2 – Pediatrician

Setting description

Parent and child talking to doctor at doctor office. Parent says that the child already got COVID from a classmate at schools so since they already have had it (and built that immunity) then the parents doesn't see why they child should get the vaccine (they see it as redundant).

Script

Doctor: Would you like to vaccinate Luis today? We have both the flu and covid vaccine available in our office.

Parent: We don't usually get the flu vaccine, so I am not sure. And Luis was exposed to a classmate that tested positive for Covid, so I think he had it. What is the point of getting the covid vaccine now that he had it?

Doctor: So you think that Luis had covid? Where you able to get an at-home test to test him?

Parent: I wasn't able to find one, but his whole class had to quarantine, and Luis had a fever for 2 days. He coughed and had a runny nose. So, because of all this I assume that he was sick with covid.

Doctor: OK. I see. I think it is safe to assume that he might have had covid since he was exposed to it and had some symptoms. I can have him tested for antibodies to confirm that he was sick with covid and not something else. Would you like to do that?

Parent: Sure.

Doctor: But I still recommend Luis gets the covid vaccine, because there are benefits to getting vaccinated even if he was sick with covid in the past. If he gets vaccinated now, he could avoid severe symptoms if he gets infected again. The virus has lots of variants, and each variant is different. Some variants cause more severe symptoms than others. Getting the vaccine will make Luis a lot safer. It will make him a lot less likely to get seriously ill from covid in the future.

Parent: But since he was sick already, doesn't he have natural immunity now?

Doctor: He does to some extent. But we are still learning about how long this natural immunity lasts and how good it is at preventing future reinfections. With the COVID vaccine there is clinical data to show how many antibodies are created by body after the vaccine. That is why we are more confident in the immunity created from the vaccines to prevent another infection. And you wouldn't just be protecting him. If you can help him not get reinfected, you will also protect everyone around him, including your family members and other kids at school.

Parent: OK. I see. Then yes, he should get the COVID vaccine.

END

Stock video screenshot



Video 3 – Couple

Setting description

Couple talking if the woman should get the vaccine since she is pregnant. They worry about the effects of the vaccine on the developing fetus.

Script

Woman: So today at my prenatal appointment, my doctor asked me if I wanted to get the covid vaccines. I wasn't sure if I should get them. I was worried if it will be bad for the baby and I said that I wanted to talk to you too.

Man: Why do you think that the vaccine is bad? What did the doctor say?

Woman: Well, she said that the vaccine is safe for pregnant women. That pregnant women were part of the trial when they tested the safety of the vaccine and that there were no impacts on the baby.

Man: Ok so then what is bothering you?

Woman: Well, I wanted to get your thoughts since it's about our baby. But the doctor also said that because I'm pregnant I am more likely to get severely ill if I get sick with covid, because my body is working over-time to protect me and the baby.

Man: Then that sounds like a good reason to get it. Look, I found on the CDC website that if you get the vaccine while you are pregnant, you can pass some of your antibodies to the baby, and that way the baby can be protected when they are born.

Woman: Oh right, I forgot about that. The doctor told me about that too. Then you think I should do it?

Man: Do you think you should do it?

Woman: I think so.

Man: Yes, I think so too.

Woman: Ok, I'll call the doctor tomorrow.

END

Stock video screenshot



Appendix D: Pre- and Post-Session Questions

Pre-Interview Questions

- 1) Do you know how the COVID -19 vaccines create immunity in the body?
- 2) If a person was sick with COVID-19 and they are not vaccinated, can they become sick with COVID-19 again? Why?
- 3) Do you know what are the possible side effects of the COVID-19 vaccine?
- 4) Can the COVID-19 vaccine infect you with the COVID-19 virus?
- 5) Who can receive the COVID-19 vaccine?

Post-Interview Questions

- 1) How do the COVID-19 vaccines help your body build protection against the COVID-19 virus?
- 2) For a person that is not vaccinated but was sick with COVID-19 in the past, can they become sick with COVID-19 again?
- 3) What are some possible side effects from getting the COVID-19 vaccine?
- 4) Are you infected with the COVID-19 virus when you get the COVID-19 vaccine?
- 5) Who is qualified to receive the COVID-19 vaccine?